

REMARKS

Claims 1-16 are pending in this application. Non-elected claims 6-11 are withdrawn from consideration by the Examiner. By this Amendment, claims 1, 2, and 13-16 are amended. Support for the amendment to the claims may be found, for example, in the original claims and specification. No new matter is added.

In view of the foregoing amendments and following remarks, reconsideration and allowance are respectfully requested.

I. Rejection Under 35 U.S.C. §112

The Office Action rejects claims 1-5 and 12 under 35 U.S.C. §112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claims the subject matter which Applicants regard as the invention.

By this Amendment, claim 1 is amended to recite:

1. A composite material comprising:
a reinforcing resin, and
coated reinforcing fibers each comprising a reinforcing fiber and a coating, the coating comprising polyphenylene sulfide,
wherein a proportion of polyphenylene sulfide relative to the reinforcing fibers is 0.001 to < 0.01 percent by weight.

Applicants respectfully submit that these amendments to claim 1 should obviate the ambiguities indicated in the Office Action at item no. 7 beginning on page 3. Thus, reconsideration and withdrawal of the rejection are respectfully requested.

II. Rejection Under 35 U.S.C. §103

A. The Claimed Invention Produces Unexpected Results

Independent claims 1 and 13 recite, in part, "coated reinforcing fibers each comprising a reinforcing fiber and a coating, the coating comprising polyphenylene sulfide, wherein a proportion of polyphenylene sulfide relative to the reinforcing fibers is 0.001 to < 0.01 percent by weight." As described in the present specification at paragraphs [0004] to [0006], Examples 1 and 2, and the Table, the claimed coating having PPS in a content in the claimed

range produces an unexpected improvement in the apparent interlaminar shear strength ("ILSS") and of the bending strength ("BS") of the composite material containing reinforcing fibers, as compared to a composite material containing reinforcing fibers lacking a coating containing PPS. Moreover, there is a maximum PPS content at which ILSS and the BS are optimized; above this maximum PPS content, a decrease in the ILSS occurs. Thus, it is clearly demonstrated that the claimed content of PPS is critical and produces unexpected results.

B. Claims 1-5 and 12

The Office Action rejects claims 1-5 and 12 under 35 U.S.C. §103(a) as having been obvious over Shue in view of Harris. Applicants respectfully traverse this rejection.

Claim 1 requires that "a proportion of polyphenylene sulfide relative to the reinforcing fibers is 0.001 to < 0.01 percent by weight." As acknowledged by the Office Action on page 5, Shue does not teach or suggest such a feature.

Despite its asserted disclosures, Harris fails to cure the deficiencies of Shue. Harris discloses miscible poly(aryl ether ketone) blends that contain from about 98 to 99.9% by weight of a miscible poly(aryl ether ketone) blend, and from about 0.1 to about 2% of a poly(phenylene sulfide) (PPS). See abstract. Thus, Harris discloses a proportion of PPS relative to the miscible poly(aryl ether ketone) blend is 0.1 to 2 percent by weight. However, claim 1 recites the proportion of PPS relative to the reinforcing fibers. Although Harris mentions in passing that the compositions may include reinforcing fibers (see column 22, lines 36-38), Harris fails to disclose what amounts of fibers may be used in its composition, or provide any disclosure that would teach or otherwise suggest any ratio of the weight % of PPS to reinforcing fibers.

Furthermore, Harris does not disclose using an amount of PPS less than about 0.1 wt%. Harris states in the sentence beginning on line 16 of column 4, "The discovery that

such small amounts of the additive (< 2 weight percent) are effective in promoting fast crystallization rates was totally unexpected." However, this parenthetical of "< 2 weight percent" follows the clause "such small amounts of the additive," which clearly refers to the preceding sentence that discloses "from about 0.1 to about 2.0 percent by weight of poly(phenylene sulfide)." Nowhere does Harris teach or suggest that any amounts of less than 0.1 wt% of PPS can achieve the results described therein. Thus, Harris cannot be reasonably considered to teach or suggest an amount of 0.001 to < 0.01 wt% of PPS.

Thus, because Harris fails to teach, suggest, or otherwise recognize a range of a proportion of PPS to reinforcing fibers by weight percent, Harris cannot be fairly considered to provide a reason or rationale to modify the teachings of Shue with regard to the ratio of PPS to the reinforcing fibers.

Furthermore, in addition to the fact that Harris fails to cure the deficiencies of Shue, Applicants respectfully submit that the combination of Shue and Harris is improper.

The Office Action asserts that because Shue and Harris are both directed to coatings containing PPS and reinforcing fibers, the art is analogous. Applicants respectfully disagree.

Shue generally discloses polymer-coated reinforcement fibers for composite materials. See Abstract. In order to improve certain properties, such as strength, stiffness and fatigue life, the reinforcement fibers are coated with a curable polymer, such as PPS. See column 1, lines 1-52. Shue describes that the content of the polymer ranges is from about 0.1 to about 10 wt.% relative to the total weight of the polymer and the reinforcements. See column 3, lines 23-28. Preferably, the content range is from 6 to about 8 wt.% relative to the total weight of the polymer and the reinforcements. See column 3, lines 24-26. In the Example, Shue discloses that the ratio of the PPS polymer coating to the carbon fibers is 7 wt.%. According to the Example, the PPS-coated carbon fibers are then compounded with PPS resin to obtain a reinforced plastic.

Harris is directed to miscible poly(aryl ether ketone) blends ("PAEK" blends). Harris describes that PAEKs are crystalline polymers with melting points above 300°C and display exceptional high temperature performance. See column 1, lines 20-23. Harris further discloses that although PAEKs have potential for a wide variety of uses, they are expensive polymers. See column 2, lines 17-19. Due to their thermal and hydrolytic stability, high strength and toughness, wear and abrasion resistance, and solvent resistance, PAEKs are especially suitable where such high performance is required. However, in some situations the glass transition temperature of a PAEK alone may not be sufficient and, therefore, it may be blended with other thermoplastics having a higher glass transition temperature. See column 2, lines 37-55.

Harris further discusses that it is known that polymers are generally immiscible and that it is impossible to predict whether a given polymer pair will yield a miscible blend. See column 2, lines 56-69. However, it had been previously discovered that PAEKs can form miscible blends with imide-containing polymers and polyetherimides. See column 3, lines 10-17. Harris discloses that:

Crystallization rates are even more critical in miscible blends containing a poly(aryl ether ketone) and an amorphous polymer, such as for example, a poly(ether imide) or certain polyimides and poly(amideimides). The presence of the second polymer component retards crystallization and, hence, the development of optimum toughness, optimum chemical, and heat resistance.

It is, therefore, highly desirable to develop new rapidly crystallizing miscible poly(aryl ether ketone) blend compositions, while retaining at the same time, all of the other attractive features of this class of polymers.

See column 3, lines 31-42.

Therefore, Harris is concerned with a very specific problem with a specified class of miscible polymers. In other words, the disclosure of Harris is related to improved

crystallization rates of PAEKs blended with a polyetherimide, certain poly(amide-imides) and/or polyimides. See column 4, lines 10-13.

Harris discovered that by adding PPS to such PAEK miscible blends in an amount from about 0.1 to about 2% by weight significantly improves the crystallization rate of those specific polymer blends. See column 4, lines 8-21.

Nowhere does Harris discuss, suggest, or otherwise contemplate improving properties of reinforcement fibers, such as strength, stiffness, and fatigue life as discussed by Shue. In fact, the only thing that can be said that is in common with the two disclosures is that they both mention PPS. The fact that Harris mentions in passing that reinforcing fibers such as fiberglass, carbon fibers, and the like may be used in its compositions (see column 22, lines 36-39) can not, by itself, substantiate the Office Action's assertions that Shue and Harris are analogous. Instead, because of the fact that the U.S. classifications and fields of search for Shue and Harris (see fields [52] and [58] on the faces of the corresponding patents) are completely different, and Shue and Harris are each concerned with very different technical problems that have no relation to each other, Applicants respectfully submit that the references are not analogous to each other. Similarly, Harris cannot be considered analogous art to the instant application for reasons similar to those discussed above. For at least this reason, Applicants respect to submit that the rejection is improper.

The Office Action further asserts that it would have been obvious to one of ordinary skill in the art at the time of invention to utilize the coating composition of Harris in place of the coating composition as disclosed by Shue for the added benefit of a faster crystallization which would give a final product made with the compositions excellent mechanical properties as well as excellent chemical and heat resistance. First, Shue does not disclose that miscible polymer blends are used in its invention, let alone provide any discussion regarding miscible

PAEK polymer blends. Second, Shue does not discuss any problems with crystallization rates. Third, Shue discloses that the polymer coatings can be 100% PPS.

Furthermore, the assertion that the coating composition of Harris would crystallize faster than a coating composition of Shue is a conclusory statement unsubstantiated by any evidentiary facts or a well reasoned argument based on established scientific principles. As discussed above, the problem discussed by Harris is the general immiscibility of polymer blends, or in other words, the general inability of polymer blends to crystallize together. However, if one of skill in the art was to start with a 100% PPS polymer as disclosed in Shue, one would not expect to have any of the crystallization problems outlined by Harris. And, as also discussed above, Harris is directed to adding a small amount of PPS to a very specific class of polymers to improve crystallization rates. However, nowhere does Harris teach or suggest that the crystallization rates of any other polymers or polymer blends can be improved by adding PPS.

Therefore, the reason or rationale provided by the Office Action that it would have been obvious to combine Shue and Harris to obtain faster crystallization rates is completely without merit and fails to consider the teachings of the references as a whole.

The Office Action alternatively asserts that it would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the percent of PPS because one of skill in the art would have been motivated by the desire to optimize the crystallization rates as disclosed by Harris. Again, as discussed above, there is no indication that the polymer blends disclosed by Harris would actually crystallize faster than the polymer coating disclosed by Shue. Furthermore, where Shue discloses a 100% PPS polymer coating, it would be nonsensical for one of skill in the art to decrease the amount of PPS in a 100% PPS polymer coating to achieve faster crystallization rates. In fact, suggesting that this is the way that Shue would be modified in light of Harris would be completely incorrect, as Harris

teaches adding PPS to a PAEK polymer blend to increase the crystallization rate. However, it would be nonsensical for one of skill in the art to add PPS to Shue's polymer coating that is already 100% PPS.

Finally, the Office Action also asserts that it would have been obvious to one of ordinary skill in the art to utilize the lesser amounts of PPS to save materials and cut costs. As discussed above, Harris cannot be fairly considered to teach decreasing the amount of PPS but, rather, teaches adding small amounts of PPS to a PAEK blend to increase crystallization rates. Additionally, as also discussed above, Harris discloses that PAEKs are expensive polymers.

For at least all of these reasons, claim 1 and the claims dependent therefrom would not have been rendered obvious by the combination of Shue and Harris. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

C. Claims 13-16

The Office Action rejects claims 13-16 under 35 U.S.C. §103(a) as having been obvious over Harris. Applicants respectfully traverse this rejection.

Claim 13 recites, "Coated reinforcing fibers each comprising a reinforcing fiber and a coating, the coating comprising polyphenylene sulfide, wherein a proportion of polyphenylene sulfide relative to the reinforcing fibers is 0.001 to < 0.01 percent by weight." Despite its asserted disclosures, Harris does not disclose such a combination of features.

Harris discloses a proportion of PPS relative to the miscible poly(aryl ether ketone) blend is 0.01 to 2 percent by weight. However, claim 13 recites the proportion of PPS relative to the reinforcing fibers. Although Harris mentions in passing that the compositions may include reinforcing fibers (see column 22, lines 36-38), Harris fails to disclose what amounts of fibers may be used in its compositions, or provide any disclosure that would teach or otherwise suggest any ratio of the weight % of PPS to reinforcing fibers.

The Office Action again asserts that it would have been obvious to one of skill in the art at the time invention to optimize the amount of PPS based upon the teachings of Harris. However, Harris simply does not disclose any ratio of the weight of PPS relative to the weight of reinforcing fibers. It is well settled that a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). Because Harris fails to recognize the particular parameter of "a proportion of polyphenylene sulfide relative to the reinforcing fibers," it would have been *per se* non-obvious for one of skill in the art at the time of invention to modify the teachings of Harris in the manner suggested by the Office Action and arrive at the subject matter of claim 13.

For at least these reasons, claims 13-16 would not have been rendered obvious by Harris. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

III. Rejoinder

Applicants also respectfully request rejoinder of withdrawn claims 6-11. PCT Rule 13.1 provides that an "international application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept." PCT Rule 13.2 states:

Where a group of inventions is claimed in one and the same international application, the requirement of unity of invention referred to in Rule 13.1 shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features. The expression "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

Applicants respectfully submit that each of claims 1-16 share the following technical feature: coated reinforcing fibers each comprising a reinforcing fiber and a coating, the coating comprising polyphenylene sulfide, wherein a proportion of polyphenylene sulfide

relative to the reinforcing fibers is 0.001 to < 0.01 percent by weight. Because there is nothing on the record that establishes that this technical feature does not define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art, unity of invention exists among claims 1-16.

Accordingly, Applicant respectfully requests withdrawal of the restriction requirement and rejoinder of withdrawn claims 6-11.

IV. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of this application are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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